

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: PCT/EP00/03631  
PAJUNEN, Esko *et al.*

Serial No. \_\_\_\_\_

Art Unit \_\_\_\_\_

Confirmation No. 9675

Filed: October 19, 2001

For: **METHOD AND APPARATUS FOR THE CONTINUOUS  
BIOCATALYTIC CONVERSION OF AQUEOUS SOLUTIONS,  
HAVING ONE OR MORE DEGASSING STAGES**

Assistant Director for Patents

Washington, DC 20231

ET 724117952 US

**PRELIMINARY AMENDMENT**

Sir:

Please enter the following amendments for the above-identified application.

No new matter has been added herein. If any fees for this paper are required, the

Commissioner is hereby authorized to charge them to Deposit Account 50-1564.

**In the Claims:**

Please amend claims 1 and 3-12 and 16-24 as follows:

**Amended Claims in Clean Form**

1. A method for the continuous biocatalytic conversion of aqueous solutions containing biocatalytically convertible material in a reactor having one or more converting/degassing stages in parallel or serial interconnection, each converting/degassing stage comprising at least one bioreactor and at least one degassing device, where the bioreactor and the degassing device are in serial connection; where in the method comprises the steps of:

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- a) in a first process step an aqueous solution containing biocatalytically convertible material is fed to the inlet of the bioreactor where it is contacted with a biocatalyst under formation of a biocatalytically converted solution containing at least one gas and at least one product; and
- b) a second process step wherein the biocatalytically converted solution is transferred from an outlet of the bioreactor to an inlet of the degassing device, where it is at least partially degassed to form a degassed solution and at least part of the degassed solution leaving the outlet of the last degassing device, is fed to the inlet of the first bioreactor in line, in a continuous flow.

- 3. Method according to claim 1, characterized in that the degassing device is a gas permeable membrane unit, a hydrocyclone or a flash tank of a combination of two or more of them.
- 4. Method according to claim 1, characterized in that the pressure at the inlet of the first bioreactor in line is 1.1 to 10 bar.
- 5. Method according to claim 1, characterized in that the converting/degassing stages are parallel interconnected.
- 6. Method according to claim 1, characterized in that the number of converting/degassing stages is 1 to 100.
- 7. Method according to claim 1, characterized in that the biocatalytically converted solution is treated to remove insoluble solids from it before entering the degassing device.

8. Method according to claim 1, characterized in that the temperature of the solution is adjusted after one or more degassing stages in a heat exchanger.
9. Method according to claim 1, characterized in that the biocatalyst is immobilized on a carrier.
10. Method according to claim 1, characterized in that the biocatalyst is yeast.
11. Method according to claim 1, characterized in that the aqueous solution containing biocatalytically convertible material is wort.
12. Method according to claim 1, characterized in that the solution is green beer.
16. Apparatus according to claim 13, characterized in that it comprises two or more converting/degassing stages.
17. Apparatus according to claim 13, characterized in that at least one bioreactor is a stirred tank reactor, a fluidized bed reactor, a basket reactor, a plug flow reactor, or a membrane filter reactor.
18. Apparatus according to claim 13, characterized in that at least one degassing device is a gas permeable unit, hydrocyclone, or a flash tank
19. Apparatus according to claim 13 further comprising at least one device for removing solids, having a discharge line for removed solids, positioned in said circuit line upstream or downstream of a bioreactor.
20. Apparatus according to claim 19, characterized in that at least one device for removing solids comprises at least one centrifuge or filter.
21. Apparatus according to claim 20, characterized in that the device for removing solids comprises a disc stack centrifuge.
22. Apparatus according to claim 13, further comprising at least one heat exchanger.

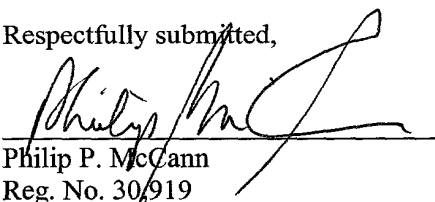
23. Apparatus according to claim 22, characterized in that the at least one heat exchanger is positioned at a location downstream of the degassing device.
24. Apparatus according to claim 22, characterized in that the at least one heat exchanger is positioned between the device for circulating the aqueous solution and the feed line.

### Remarks

Applicant respectfully requests reconsideration of the application and the claims in view of the following amendments and remarks.

Based on the foregoing amendments and remarks, allowance of the claims in the application is requested.

Respectfully submitted,

  
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Date: October 19, 2001

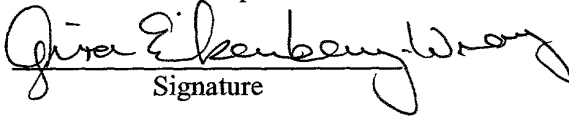
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**Marked-Up Version Showing Changes**

In the Claims:

1. A method for the continuous biocatalytic conversion of aqueous solutions containing biocatalytically convertible material in a reactor having one or more converting/degassing stages in parallel or serial interconnection, each converting/degassing stage comprising [a] at least one bioreactor [or two or more bioreactors] and [a] at least one degassing device [or two or more degassing devices], where the bioreactor [or the bioreactors] and the degassing device [or the degassing devices] are in serial connection[.]; where in [each converting/degassing stage] the method comprises the steps of:
  - a) in a first process step an aqueous solution containing biocatalytically convertible material is fed to the inlet of the bioreactor

where it is contacted with a biocatalyst under formation of a biocatalytically converted solution containing at least one gas and at least one product<sub>i</sub>; and

b) [where in] a second process step wherein the biocatalytically converted solution is transferred from an outlet of the bioreactor [or a common outlet line] to an inlet of the degassing device [or a common inlet line to two or more degassing devices], where it is at least partially degassed to form a degassed solution and at least part of the degassed solution leaving the outlet of the last degassing device [or a common outlet of two or more last degassing devices in line], is fed to the inlet of the first bioreactor in line [or two or more first bioreactors], in a continuous flow.

3. Method according to claim 1[or 2], characterized in that the degassing device is a gas permeable membrane unit, a hydrocyclone or a flash tank of a combination of two or more of them.
4. Method according to [one of claims] claim 1[ to 3], characterized in that the pressure at the inlet of the first bioreactor in line is [1,1] 1.1 to 10 bar.
5. Method according to [one of claims] claim 1[ to 4], characterized in that the converting/degassing stages are parallel interconnected.
6. Method according to [one of claims] claim 1[ to 4], characterized in that the number of converting/degassing stages is 1 to 100.
7. Method according to [one of claims] claim 1[ to 4], characterized in that the biocatalytically converted solution is treated to remove insoluble solids from it before entering the degassing device.

8. Method according to [one of claims] claim 1[ to 4], characterized in that the temperature of the solution is adjusted after one or more degassing stages in a heat exchanger.
9. Method according to [one of claims] claim 1[ to 4], characterized in that the biocatalyst is immobilized on a carrier.
10. Method according to [one of claims] claim 1[ to 4], characterized in that the biocatalyst is yeast.
11. Method according to [one of claims] claim 1[ to 4], characterized in that the aqueous solution containing biocatalytically convertible material is wort.
12. Method according to [one of claims] claim 1[ to 4], characterized in that the solution is green beer.
16. Apparatus according to [one of claims] claim 13[ to 15], characterized in that it comprises two or more converting/degassing stages.
17. Apparatus according to [one of claims] claim 13[ to 15], characterized in that at least one bioreactor [(1)] is a stirred tank reactor, a fluidized bed reactor, a basket reactor, a plug flow reactor, or a membrane filter reactor.
18. Apparatus according to [one of claims] claim 13[ to 15], characterized in that at least one degassing device [(3)] is a gas permeable unit, hydrocyclone, or a flash tank
19. Apparatus according to [one of claims] claim 13[ to 15] further comprising at least one device [(2)] for removing solids, having a discharge line [(8)] for removed solids, positioned in said circuit line upstream or downstream of a bioreactor [(1)].
20. Apparatus according to claim 19, characterized in that at least one device [(2)] for removing solids comprises at least one centrifuge or filter.

21. Apparatus according to claim 20, characterized in that the device for removing solids comprises a disc stack centrifuge [(5)].
22. Apparatus according to [one of claims] claim 13[ to 15], further comprising at least one heat exchanger [(5)].
23. Apparatus according to claim 22, characterized in that the at least one heat exchanger [(5)] is positioned at a location downstream of the degassing device [(3)].
24. Apparatus according to claim 22, characterized in that the at least one heat exchanger [(5)] is positioned between the device [(4)] for circulating the aqueous solution and the feed line [(6)].